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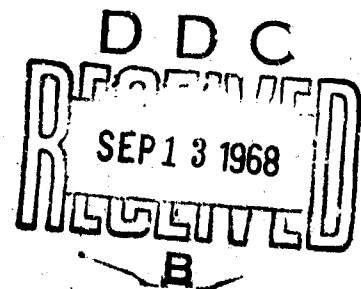
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DEPARTMENT OF THE ARMY
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OBSERVATIONS ON THE SUSCEPTIBILITY OF SOME WILD
SPECIES OF THE GENUS NICOTINA AND OF SOME
VARIETIES OF NICOTIANA TABACUM L. AND N. RUSTICA L.
TO BLUE MOULD (PERONOSPORA TABACINA ADAM) --
PULAWY 1962

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Rośliny i Gleboznawstwo, No 3, (81), 1963, pages 51-63

Exacerbation of the epidemic of blue mould in Europe has brought about the necessity for carrying out investigations on the biology and means of control of the parasite as well as on immunological breeding. The many publications on this subject which appeared during 1961-1962 [1-23] bear witness to the intensiveness of these studies.

In addition to laboratory studies, field observations are being carried out in many countries. These aim at isolating the varieties least susceptible to the blue mould, which could be of value for breeding and cultivation. Selection for the breeding of resistant varieties is carried out under field conditions [9, 19].

Following the recommendations of the Congress in Sofia, investigations on the degree of susceptibility of tobacco varieties to this disease were commenced at the Laboratory for Tobacco Breeding and Cultivation (Pracownia Hodowli i Uprawy Tytoniu), IUNG, in 1961. During the year, the investigations were expanded to cover a collection of wild species of the genus Nicotiana, varieties of makhorka, and additional varieties of tobacco.

Investigated Plant Material

The material on which observations were carried out in 1962 comprised:

1. A group of 31 wild varieties of the genus *Nicotiana*. Some of these species could be of significance in breeding.

2. A group of 63 varieties of cigarette tobaccos, mainly of foreign origin. This number includes the Pulawy-bred varieties of Maznowski's Virginia, Goldenleaf IHAR, and Niwa.

3. A group of 40 varieties of heavy tobacco, including six varieties bred in Pulawy: Havana IIc, Kentucky 3002, Rogozinski's Kentucky, Small and Large Nadwislanski, and Broadleaf Pulawski.

4. A group of 69 varieties of makhorka (*Nicotiana rustica* L.), primarily of Soviet origin, including the Pomeranian (Polish variety), Selvaggio, and Brazilian, cultivated in Poland.

No symptoms of disease were noted on inspection during the observations on the plant growth. The tobacco seedlings were planted in the field on 4 May 1962, and the varieties of makhorka and the wild varieties on 24 May 1962 (about 40 plants each for every variety or species). Cultivation and care procedures suitable for each group of species were applied during the period of growth.

Soil and Climate Conditions in 1962

The studied material grew in 1962 on an experimental field of IUNG (Pulawy, Wlostonice) earmarked for experiments on *Peronospora tabacina*. The soil -- silt of old accumulation terrace, medium-humous and light, with variable overlay of sand and medium powdery silt from 140 cm; carbonates and limestones from 150 cm.

Atmospheric conditions in 1962 (Fig. 1)* deviated markedly from the mean averages, as well as from the meteorological conditions in 1961.

Average monthly air temperatures from January to September were lower than the mean.

Precipitation was lower than the mean average only in January, July, and August. It equaled the mean in March, and exceeded it considerably in the remaining months. Particularly noteworthy was May, which was extremely wet. During May, Pulawy had 156.1 mm of rainfall, and the Vistula valley (Pulawy--Kopin) up to 176.9 mm -- against the mean average for May of 64.6 mm of rainfall. May was simultaneously cold (average temperature 11.5°C; mean average -- 13.6°C) and cloudy. There were only 105.6 sunshine hours during May (mean average -- 242 sunshine hours), which was the lowest on record in 39 years.

The low temperature, little sunshine, and the high humidity of the air (absolute humidity 79 percent, mean average -- 70 percent, contributed to very low evaporation. The soil was excessively wet, which affected badly the development of the plants in May.

* For figures, see Appendix

Sunlight exceeded the mean average only during January, and was considerably below average in the remaining months.

On the whole, atmospheric conditions during the growth period in 1961 were not favorable for the growth of the tobacco (a distinctly thermophilic plant), but were also detrimental to the growth of the mould (low temperature).

Methods

In order to hasten the infection of the plants by *Peronospora tabacina*, all the plants of the experimental fields were infected artificially with an aqueous suspension of the conidia on 8 Aug 1962 (when the first, natural foci of the mould were discovered). According to the calculations, one milliliter of water contained about 22,000 conidia.

The first manifestations of the disease appeared more or less after 10 days from the day of the infection. The observations were made in a manner identical to that in 1961 (2), defining the percentage of diseased plants and the degree of their infection in accordance with a five-degree scale (in accordance with the recommendations of the Congress in Sofia): 0° -- no infection, 1° -- individual necrotic spots without spores, 2° -- spots cover a 5--20 per cent area of the leaves and the fungus is in the sporulation stage, 3° -- spots cover 20--40 per cent of the leaves with the appearance of sporulation, and 4° -- spores cover more than 40 per cent of the leaves' surface and the leaves rot.

The first detailed observations were carried out on 21 Aug 1962 on the cigarette, heavy, and wild species of tobacco, and on 24 Aug 1962 -- on the varieties of makhorka.

The spread of the disease was not as rapid as in 1961 and, consequently, the second set of observations was made as late as 10, 11, and 17 Sep 62. The degree of infection of the plants was defined during the last observations.

Findings

The first, natural foci of the mould were discovered on 6 Aug 1962 (in 1961, already on 30 Jul). They appeared on the varieties: Samsun 935, Sharp-leaf Krasnodar, Sharp-leaf 2746 and 2747, Kozarsko 541, Stanimascho pembe, Ustinshi 4, Begej 4, Chebli, Jaka, Rhisan Burley A, Virginia Joyner, Kaznowski's Virginia, Goldleaf IMAR, Goldleaf 113 and 248, Brazilian Yellow, 61655, Cabot, and Havana III/3.

The results of the observations made on 6 Aug are not given numerically, in view of the very weak symptoms of the disease.

Results of the later observations are represented graphically, for each group (species or variety) separately (Figs. 2, 3, 5, and 6).

The results of the observations on the wild species of *Nicotiana* are given in Fig. 2. Most species showed symptoms of the mould. Only *Nicotiana debneyi* and *Nicotiana exigua* appeared entirely healthy, and *Nicotiana paniculata* and *Nicotiana plumbaginifolia* showed very faint symptoms of the disease. *Nicotiana glauca* exhibited weaker manifestations of the infection than the other species in the initial period of infection, but the spread of the disease in this species was so rapid that by early September, even all inflorescence was infected, and the plants died. Also strongly infected was the species of *Nicotiana glutinosa*.

Of the varieties of cigarette tobacco (Fig. 3), the Hicks Resistant (seeds obtained from Dresden and Bergerac) and the Hicks fixed A₂ (seeds from Forchheim) were completely resistant under field conditions. Of the remaining varieties, the oriental tobaccos Nova Crnja, Prilep, and Samsun H proved distinctive.

Most strongly infected were the varieties Aurelius, Bright 102, Burley Giuseppina T. 428 and Burley G. R. Marca 645 (Fig. 4), Rhisan Burley A, Chebli, Malowata 2613, Virginia 230, Virgin SCR, and others.

Distinctive among the heavy tobaccos (Fig. 5) were the varieties Dragon Vert, Greenwood, H-27-5, Havana IIc, and Havana III/3. Most strongly infected were the varieties Havana 307, Kentucky Gig. No 2 T/371, Wisconsin Havana 172, and Wisconsin Havana 307.

Varieties of *Nicotiana rustica* L. are also massively infected by *Peronospora tabacina* Adam. From our observations (Fig. 6) it appears that, from among the 69 varieties of makhorka, only Kapa (Fig. 7), Komarno, Komarno VII (Fig. 8), and Selvaggio (Fig. 9) exhibit stronger resistance to blue mould than the other varieties.

Most strongly infected were the following varieties of makhorka: Baskun, Bakun Krzemieniecki, Kurozavaya 196, Limonka, Brazilian, Salombii, Sinka, Sizaya Konotopskaya, Szvicent flawa, Tiechleo 32/34, Toumbeck, Toirac, Wolodsko-Dziewicka, Zabka, Yellow, Yellow 247, Yellow 106, and Yellow 103 (Fig. 10).

Conclusions

Observations carried out in the field (in natural conditions and with additional, artificial infection) permit to draw the following conclusions:

1. The course of the blue mould epidemic is affected by atmospheric conditions, as was established in 1961, (2). In 1962, the epidemic of the mould in the experimental fields of IUNG in Pulawy appeared later and was

milder than the year before. This remains unquestionably connected with the course of the weather in the spring and summer, which was unfavorable for the growth of the parasite.

2. It was established, on the basis of the observations in 1962 (and previously in 1961) that, under the same conditions, not all of the species and varieties of the studied material were equally susceptible to blue mould, as witnessed by the differences in the degree of infection and percentage of diseased plants.

3. Among the wild species of *Nicotiana*, no manifestations of the mould were observed on the species of *N. debneyi* and *N. exigua*. This conforms with the findings of other authors (9, 19, and others). Very weak symptoms appeared in *N. paniculata* and *N. plumbaginifolia*.

4. In the group of cigarette-tobacco varieties only the Hicks Resistant and Hicks fixed A₂ (varieties of Australian origin, obtained by the cross-breeding of *N. tabacum* and *N. debneyi* -- 19) proved free of the mould. Like in 1961, the group of oriental tobaccos appeared less susceptible, and most strongly infected were the varieties of the "Aurea" type.

5. The varieties of heavy tobacco were not infected as strongly as in 1961. One should, however, assume that this was due rather to the milder course of the disease (connected with unfavorable weather conditions), and not to the lesser susceptibility of these varieties (for example, the Dragan Vert belonged in 1962 among the weakly infected varieties, whereas the year before it showed 98 per cent infected plants and degree 3 of infection -- 2). Like in 1961, no completely healthy varieties were noted among the members of this group.

6. No resistant varieties were noted among the group of *Nicotiana rustica* L. There are, however, great variations in the degree of susceptibility of the individual varieties. Least susceptible to the disease in 1962 were Komarno VII, Kapa, Komarno, and Selvaggio. It appears also that the varieties of makhorka with bright leaves (for example, Limonka, Zabka, and all Yellow) are more susceptible to the blue mould than the varieties with dark-green leaves (just as the Aurea type varieties in *N. tabacum* L.).

Figure Appendix

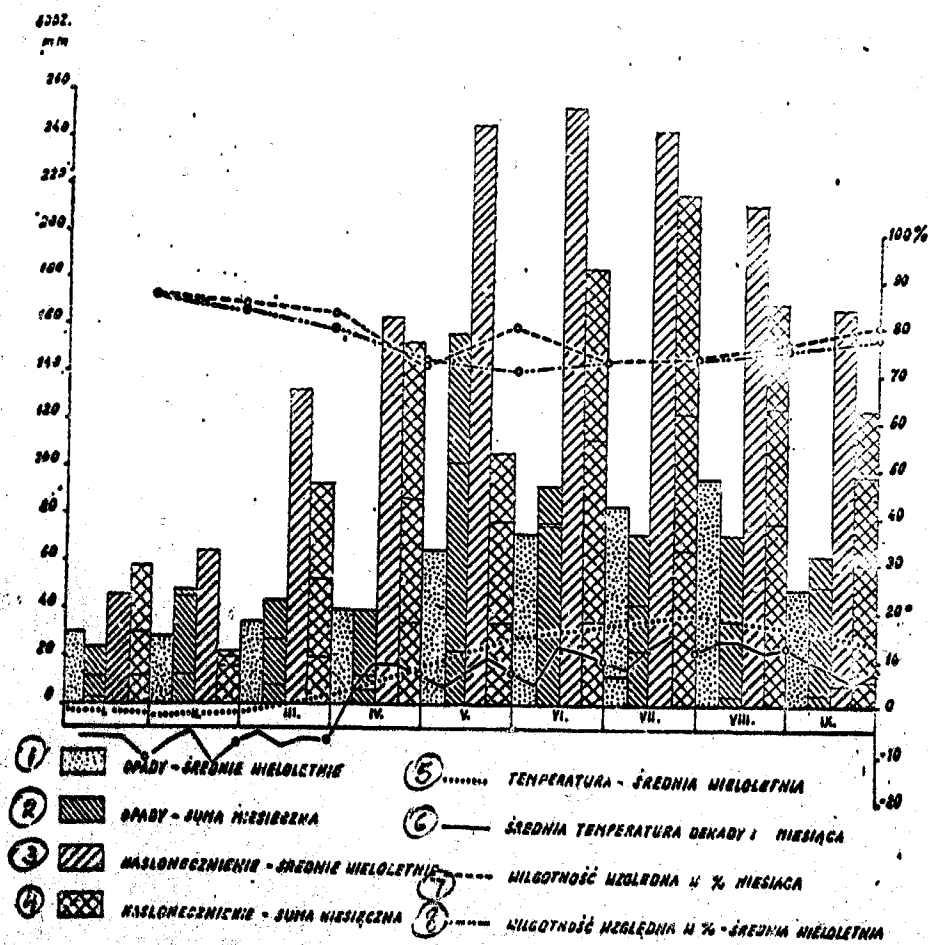


Fig. 1. Meteorological data for the period Jan-Sep 1962 (according to the records of the Main Meteorological Station in Pulawy).

Key: 1) Precipitation; Mean average; 2) Precipitation; Monthly total; 3) Sunshine; Mean average; 4) Sunshine; Monthly total; 5) Temperature; Mean average; 6) Average temperature by 10-day period and by month; 7) Absolute humidity in percent; by month; 8) Absolute humidity in percent; Mean average.

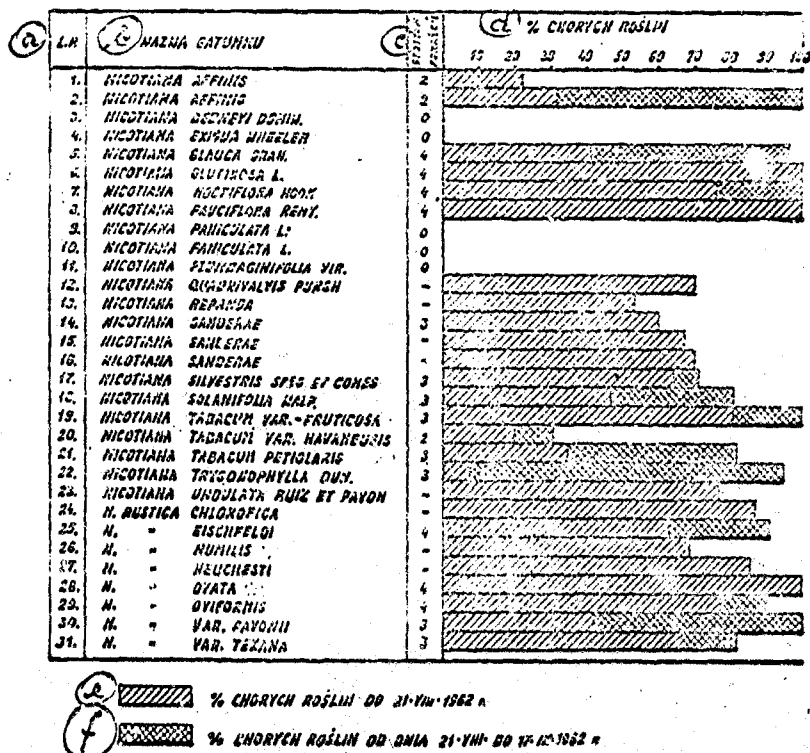


Fig. 2. Infection of wild species of *Nicotiana* by blue mould - Pulawy, 1962.

Key: a) No.; b) Name of species; c) Degree of infection; d) Percentage of diseased plants; e) Per cent diseased plants up to 21 Aug 62; f) Per cent diseased plants from 21 Aug to 17 Sep 62.

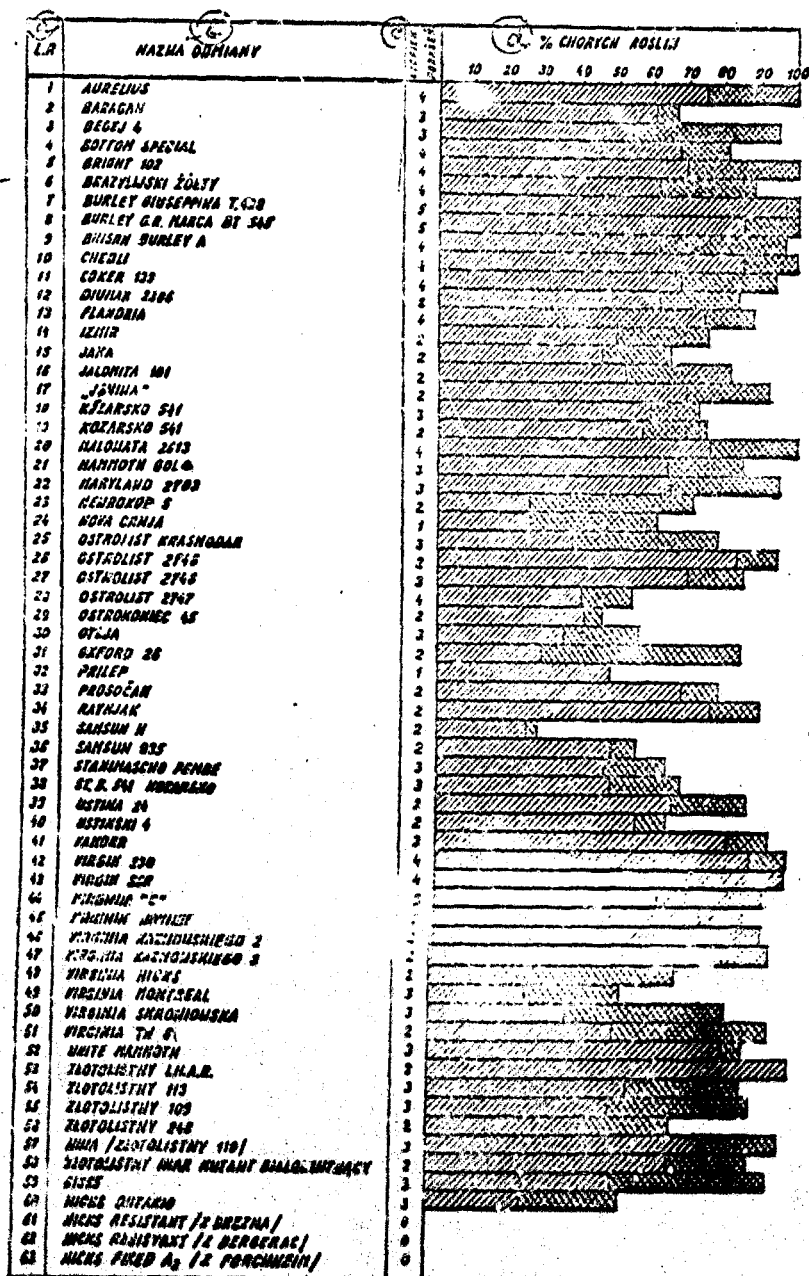


Fig. 3. Infection of cigarette-tobacco variations by blue mould - Pulawy, 1962.

Key: a) No.; b) Name of variety; c) Degree of infection; d) Per cent of diseased plants; e) Per cent diseased plants up to 21 Aug 62; f) Per cent diseased plants from 21 Aug to 10 Sep 62.

6) Brazilian Yellow; 25) Sharp-leaf Krasnodar; 26-28) Sharp-leaf; 46-47) Kasnowski's Virginia; 53) Goldenleaf IHAR; 54-56) Goldenleaf; 57) Nima /Goldenleaf 110/; 58) Goldenleaf IHAR White-blooming Mutant; 61) /from Dresden/; 62) /from Bergerac/; 63) /from Forchheim/.



Fig. 4. Tobacco varieties Burley Gineppina T 423 (0123) and Burley G. R. Marca BT 645 (0123) infected by blue mould.

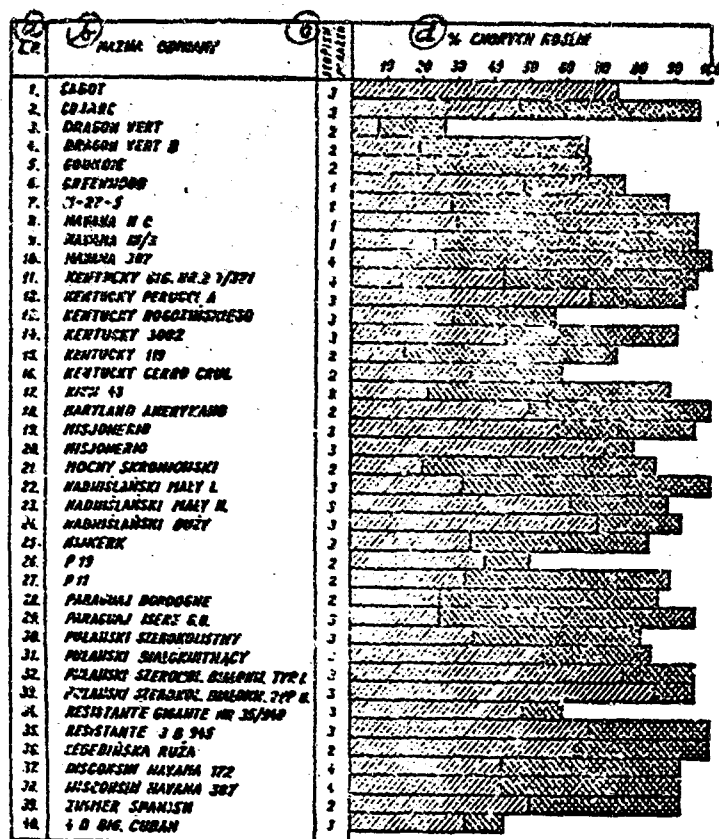
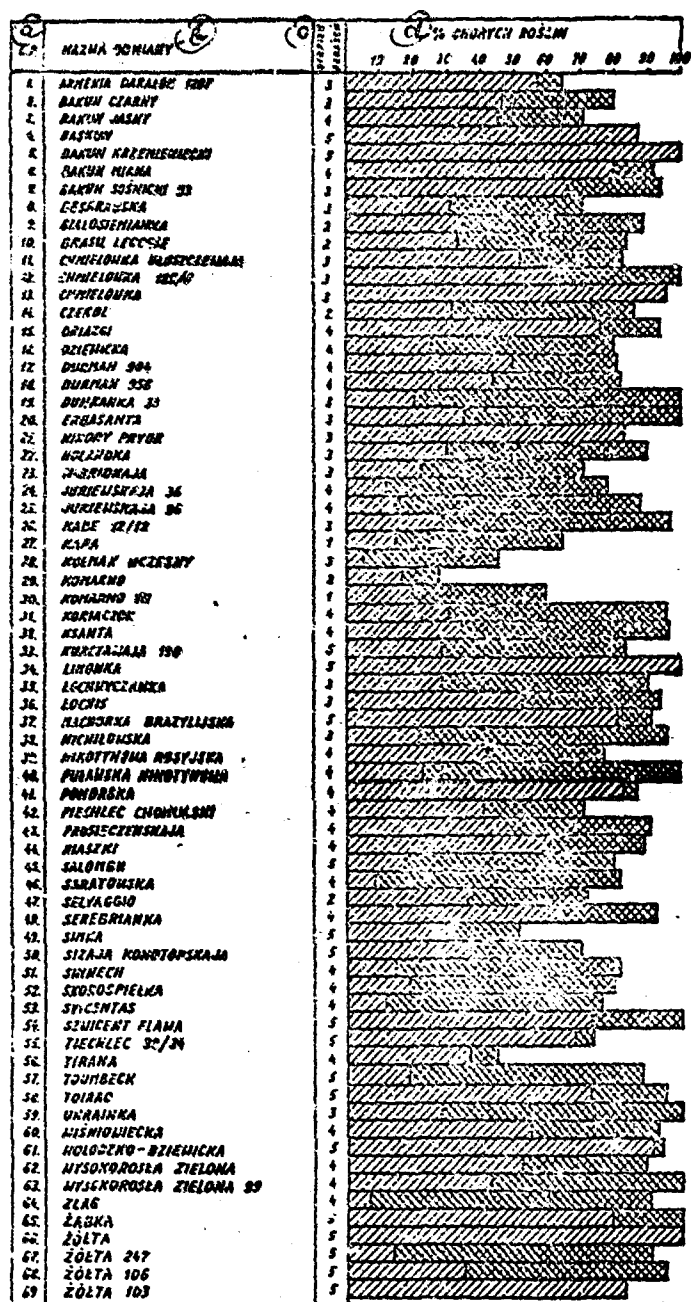


Fig. 5. Infection of heavy-tobacco varieties by blue mould - Pulawy, 1962.

Key: a) No.; b) Name of variety; c) Degree of infection; d) Per cent of diseased plants; e) Per cent diseased plants up to 21 Aug 62; f) Per cent diseased plants from 21 Aug to 11 Sep 62.
 13) Rogozinski's Kentucky; 21) Strong Skroniowski; 22) Small Nadwislanski I; 23) Small Nadwislanski II; 24) Large Nadwislanski; 30) Broadleaf Pulawski; 31) White-blooming Pulawski; 32) White-blooming Broadleaf Pulawski, Type I; 33) White-blooming Broadleaf Pulawski, Type II.



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Fig. 6. Infection of makhorka varieties (*Nicotiana rustica* L.) by blue mould - Pulawy, 1962.

Key: a) No.; b) Name of variety; c) Degree of infection; d) Per cent of diseased plants; e) Per cent diseased plants up to 24 Aug 62; f) Per cent diseased plants from 24 Aug to 11 Sep 62.

2) Black Bakun; 3) Light Bakun; 37) Brazilian Makhorka; 39) Russian Nicotinic; 40) Pulawy Nicotinic; 62) Tall-growing Green; 63) Tall-growing Green 99; 66-69) Yellow.



Fig. 7. Kapa variety of makhorka at the end of growth period (20 Sep 62) - weakly affected by the mould.



Fig. 8. Komarno VII variety of makhorka at the end of growth period (20 Sep 62) - weakly affected by the mould.

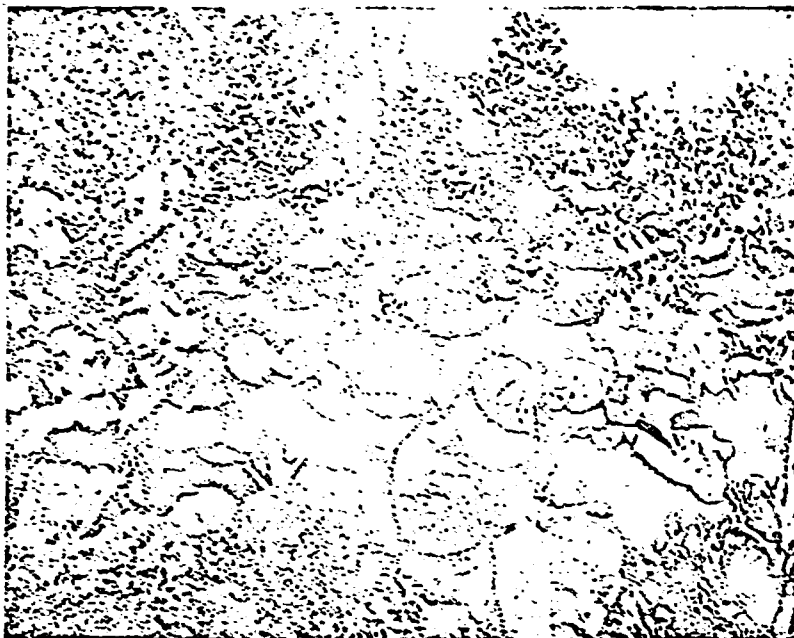


Fig. 9. Salvaggio variety of makhorka at the end of growth period (20 Sep 62) - weakly affected by the mould.



Fig. 10. Yellow 103 variety of makhorka at the end of growth period (20 Sep 62) - strongly affected by the mould.

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